REMARKS

This amendment is being filed with a Request for Continued Examination. This amendment provides a full and complete response to the Advisory Action dated April 16, 2009 and the Final Office Action mailed February 3, 2009. Applicants would like to thank the Examiner for entering the amendments filed April 2, 2009.

Claims 1, 3, 17-18, 21, 23, 26-27 and 29 have been amended and new claims 33-34 have been added to provide more clarity to the claimed invention. Applicants believe no new matter has been introduced by the amendments and the new claims presented herein. The amendments and the additional claims have been presented to put the claims in condition for allowance or in better condition for an appeal. Please reconsider the claims pending in the application for reasons discussed below.

Applicants would like to thank the Examiner for withdrawing the 112, paragraph 1 raised in the Final Office Action.

In the Final Office Action, claims 12-15, 18-19 and 21-22 are objected for depending upon cancelled claims. In the reply filed April 2, 2009, claims 12-13 have been amended to depend from claim 1, and claim 18 has been amended to depend from claim 17. Withdrawal of the objection is respectfully requested.

As stated in the Final Office Action, claims 1-8, 17, 20, 23-27 and 29-32 stand rejected under 35 USC 103(a) as being unpatentable over Hybrid Seismic Inversion: A Reconnaisance Tool For Deepwater Exploration, 11/2000 by Mallick et al. (Mallick 2000) in view of US Patent No. 6,694,261 ("Huffman").

Mallick 2000 does not teach or disclose "developing a geologic model of shallow water flow risk areas" and "performing a stratigraphic analysis on only P-wave seismic data of the geologic model to determine a control location within the only P-wave seismic data," as recited in claims 1 and 29. In the Advisory Action, the Examiner takes the position that the following section in Mallick 2000 teaches these limitations.

> The elastic earth models (consisting of P-wave velocity, density, and Poisson's ratio) obtained at each location of the prospect where prestack GAinversion was run can be used as background low-frequency impedance trends for poststack inversion and can create a hybrid inversion scheme. Two such hybrid schemes are fully described by Mallick et al. (1999) and summarized below.

> Method 1. In our first method, we compute P- and S-wave impedances from prestack data and use standard AVO processing to generate AVO intercept and AVO gradient volumes. Next, **we assume a background P-to S-wave velocity ratio**, and combine the AVO intercept and gradient volumes to generate a pseudo S-wave volume. A derivation for computing pseudo S-wave data from the AVO intercept and gradient is presented in Appendix A. Finally, we run poststack inversions on AVO intercept and pseudo S-wave volumes, using P- and S-wave impedance values from prestack inversion at discrete locations as background impedance trends. Once P- and S-wave impedances from these poststack inversions are obtained, we can compute Poisson's ratio according to Appendix B. (Mallick 2000, pages 1230-1231).

The Examiner further states that the "whole paper is directed to stratigraphic analysis." (Advisory Action, page 2). Applicants respectfully traverse the Examiner's position and this statement. This paper is not about stratigraphic analysis. Rather, this paper is about hybrid inversion. (See Title and pages 1230 and 1232). The sections from pages 1230 and 1232 are provided below for the Examiner's convenience with emphasis on the relevant sentences.

> **This paper describes a combination of prestack and poststack inversion that allows efficient inversion of large data volumes in the absence of well information. This hybrid methodology** first runs prestack genetic algorithm (GA) **inversion** at discrete locations over the entire data volume.

> **Discussion and conclusion.** We have demonstrated, using real data, how **prestack GA inversion** can estimate the earth model without any a priori well information. The inverted impedance in Figure 1c matches the impedance at the well to a reasonable accuracy, and we have achieved this match without using any impedance information from the well. The **prestack inversion** in Figure 1c therefore demonstrates that **our inversion methodology** is capable of extracting the true impedance trend from prestack seismic data alone.

In fact, in the entire paper, "stratigraphic" appears only once. The paragraph that contains the term "stratigraphic" is provided below for the Examiner's convenience.

> Comparison of Figures 1b and 1c demonstrates the need for fine discretization of the earth models in prestack inversion. Our inversion uses a full wave-equation approach
> that takes all primary, mode-converted, and interbed multiple reflections into account. To correctly model all **stratigraphic** details of the subsurface, inclusion of mode conversions and interbed multiple reflections is necessary. In addition, to correctly model thin-bed tuning effects due to these mode conversions and multiple reflections, it is necessary to discretize the earth model to one-fourth of the dominant wavelength of the input seismic data. In Figure 1b, prestack inversion used models with layers about half as thick as the wavelength at the dominant frequency of the input data. In Figure 1c, on the other hand, we used layers that were a quarter of a wavelength thick and achieved an inversion that converged closer to the true well model (Figure 1c). (Mallick 2000, page 1232) (Emphasis added).

The "stratigraphic details" mentioned in Mallick 2000 has nothing to do with performing a stratigraphic analysis on a geologic model, let alone performing a stratigraphic analysis on only P-wave seismic data of the geologic model to determine a control location within the only P-wave seismic data. As such, Mallick 2000 does not teach or disclose "developing a geologic model of shallow water flow risk areas" and "performing a stratigraphic analysis on only P-wave seismic data of the geologic model to determine a control location within the only P-wave seismic data," as recited in claim 1.

Mallick 2000 also fails to teach or disclose computing a ratio between the P-wave velocity and the S-wave velocity, as recited in claims 1 and 29. In fact, Mallick 2000 teaches away from computing this ratio. On page 1231, Mallick 2000 specifically states "we assume a background P- to S-wave velocity ratio, and combine the AVO intercept and gradient volumes to generate a pseudo S-wave volume." As such, Mallick 2000 assumes this ratio. In contrast, Applicants do not assume this ratio. Rather, Applicants compute the ratio based on the geologic model and the stratigraphic analysis performed on the geologic model. In this manner, the uncertainty of the ratio is minimized.

Like in claim 1, Mallick 2000 also does not teach or disclose "performing a stratigraphic analysis on the P-wave seismic data" and "applying a post-stack inversion on the P-wave seismic data using the elastic earth model to map a ratio between the P-wave velocity and the S-wave velocity in a three dimensional (3D) volume," as recited in

claim 26. As mentioned above, rather than computing for the ratio between the P-wave velocity and the S-wave velocity, Mallick 2000 assumes this ratio.

The Examiner concedes that Mallick 2000 does not teach or disclose identifying shallow water flow risk areas using the P-wave velocity to the S -wave velocity ratio. (Final Office Action, page 4). The Examiner attempts to supplement this missing limitation with Huffman. Nevertheless, like Mallick 2000, Huffman also does not teach or disclose "developing a geologic model of shallow water flow risk areas" and "performing a stratigraphic analysis on only P-wave seismic data of the geologic model to determine a control location within the only P-wave seismic data," as recited in claims 1 and 29; and "performing a stratigraphic analysis on the P-wave seismic data," as recited in claim 26.

Further, Huffman also does not teach or disclose computing a ratio between the P-wave velocity and the S-wave velocity, as recited in claims 1 and 29; and "applying a post-stack inversion on the P-wave seismic data using the elastic earth model to map a ratio between the P-wave velocity and the S-wave velocity in a three dimensional (3D) volume," as recited in claim 26. Huffman may appear to teach calculating the ratio. However, the S-wave velocity in Huffman is obtained from multicomponent data acquired using ocean bottom cable geophones. (See Huffman, Figure 2, column 4, line 47 to column 5, line 10 and column 12, lines 5-8). In contrast, the S-wave velocity in the claimed invention is derived from applying the pre-stack waveform inversion. In fact, claim 29 further recites "computing for S-wave velocity (Vs) using the P-wave velocity (Vp) and the Poisson's ratio," which Huffman also fails to teach. New claim 34 has also been added to clarify this limitation.

Further, Huffman does not teach or disclose "processing P-wave seismic data to enhance its stratigraphic resolution, wherein the P-wave seismic data are obtained from **marine towed streamers**," as recited in claim 26. As mentioned before, Huffman obtains multicomponent data from ocean bottom cable geophones, not from marine towed streamers.

Since neither Mallick 2000 nor Huffman, alone or in combination, teaches or discloses all the limitations recited in claims 1, 26 and 29, claims 1, 26 and 29 are patentable over Mallick 2000 and Huffman. Claims 2-8, 12-15, 17-25, 27 and 30-32 are

also patentable over Mallick 2000 and Huffman, since they depend from claims 1, 26 and 29, respectively. Withdrawal of the rejection is respectfully requested.

With regard to new claims 33-34, Applicants submit that claims 33-34 recite subject matter that is neither disclosed, taught, nor otherwise suggested by the cited references, and as such, allowance of these claims is respectfully requested.

In conclusion, the references cited by the Examiner, neither alone nor in combination, teach, show, or suggest the claimed invention. Having addressed all issues set out in the office action, Applicants respectfully submit that the claims are in condition for allowance and respectfully request that the claims be allowed.

Respectfully submitted,

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